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(54) Producing shaped metal strips for bearings

(57) A method for continuously producing shaped metal strips for producing bearings includes the steps of selectively and continuously performing more than one of the operations, including oil hole forming, embossing width adjusting, chamfering, oil groove forming and thickness adjusting operation on each of said metal strips for producing bearings as the metal strip is moved lengthwise thereof.

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FIG. 1

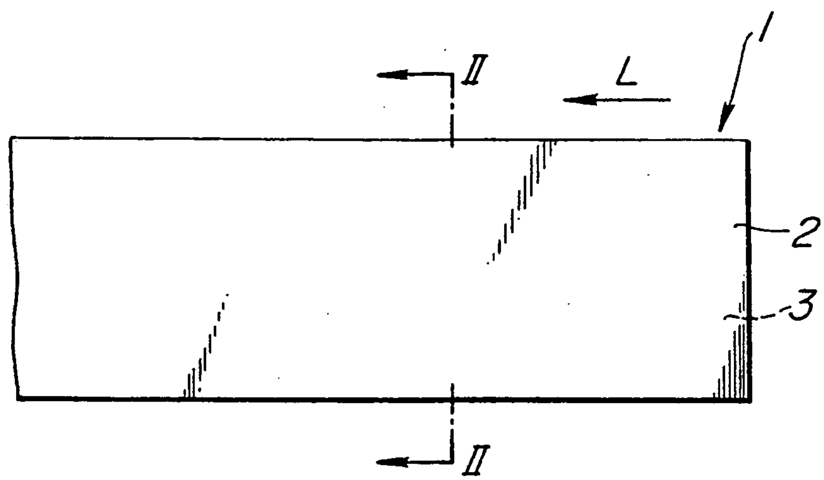

FIG. 2

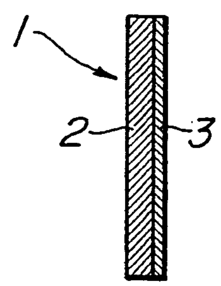

FIG. 3

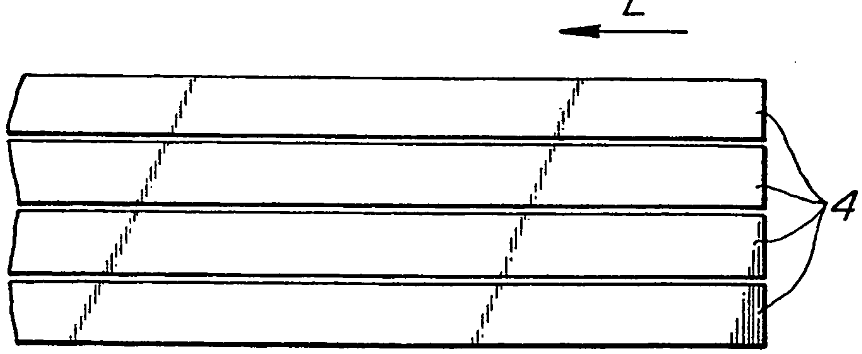

FIG. 4

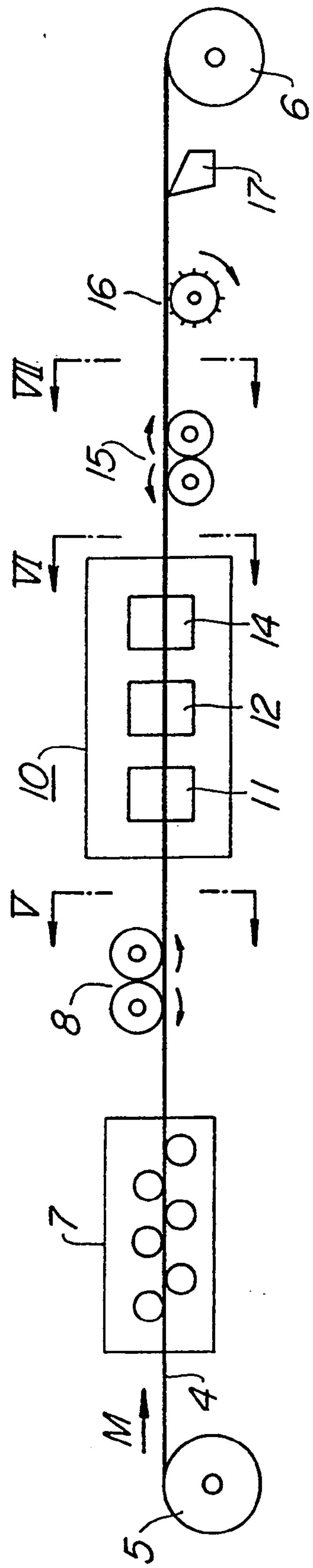

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FIG. 5

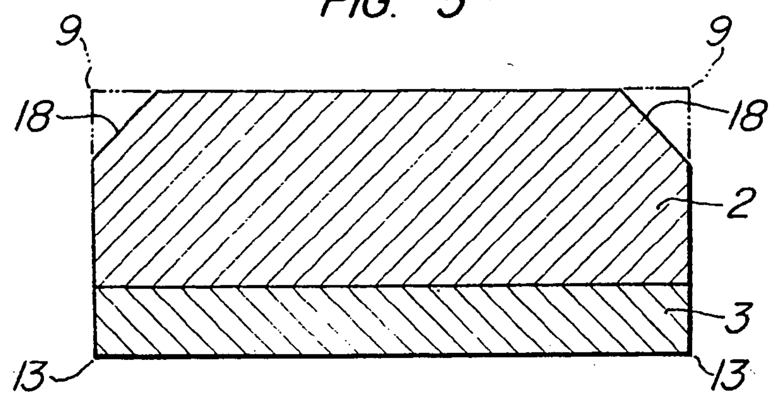


FIG. 6

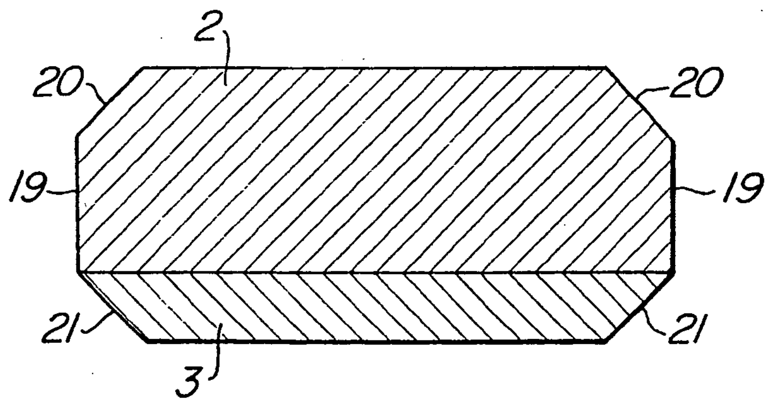
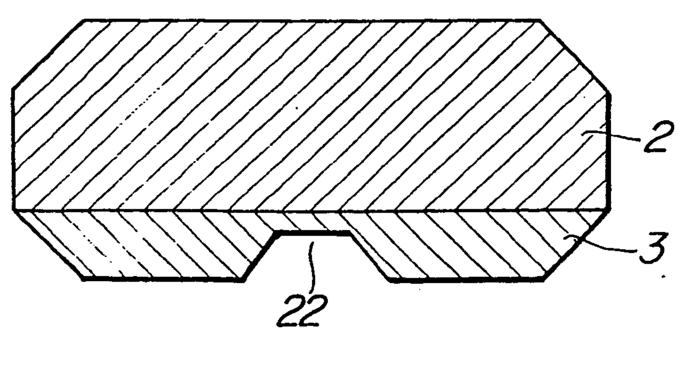


FIG. 7



SPECIFICATION

A method of continuously producing shaped metal strips

This invention relates to a method for the continuous production of shaped metal strips for bearings.

Conventional practice widely used for producing bearings from a metal strip is to punch out the metal strip widthwise thereof, by using a press, into blanks of desired shape and size and to bend the blanks widthwise thereof into a desired shape also by using a press. Then, the shaped blank is machined by following one or more of the steps including a width trimming step, a chamfering step, a thickness adjusting step, an oil groove forming step, an oil hole forming step, and oil sump forming step, etc. Some disadvantages have been encountered in connection with the aforementioned prior method. As metal strip is punched widthwise thereof according to this method, this restricts the size (outer diameter) of the product, and is low in yield rate because a large amount of waste material is inevitably formed. Thus the method is not preferable from the points of view of saving material and reducing production costs.

A proposal has been made to slit a metal strip lengthwise thereof to increase yield rate. However, even if a metal strip is cut lengthwise, namely axially into blanks, it would be necessary to leave sufficient allowance for trimming the blanks if such trimming in width is made after each blank has been cylindrically wound into a wrap-formed bush, shaped semicircularly into a semicircular thrust washer, or shaped into a bearing of the semi-cylindrical configuration, due to lack of precision with which trimming in width is made by using a single purpose machine specially adapted for effecting such trimming. Thus waste material will increase and yield rate will become low as is the case with the prior art for producing a blank by punching a metal strip transversely thereof.

Also, in the prior art, additional devices used exclusively for transporting semi-finished products must be provided for transferring the semi-finished products through a plurality of working steps to obtain end products, following shaping of a metal strip into a bearing form. This increases production cost. Moreover, various operations, such as attaching and detaching the semi-finished products to and from various working machines for performing specific working steps on the semi-finished products, must be performed intermittently, manually or mechanically thereby resulting in a reduction in production efficiency because the method must go through too many steps, and therefore, is time consuming.

According to an aspect of the present invention a method of continuously making shaped metal strips for producing bearings from metal strip of single or composite multi-layer construction comprises the steps of:

selectively and continuously performing more than one of the operations including oil hole forming, embossing, ~~width~~ adjusting, chamfering, oil groove forming and thickness adjusting operation on each of said metal strips for producing bearings as the metal strip is moved lengthwise thereof.

In an alternative method the steps comprise:

supporting each of said metal strips in a substantially horizontal plane;

selectively and continuously performing at least one of the operations of an oil hole forming, an embossing, an edge trimming, a chamfering, an oil groove forming and a thickness machining on the metal strip for producing bearings whilst said metal strip is supported in a substantially horizontal plane and is moved lengthwise thereof.

The invention provides a method of continuously producing shaped metal strips for producing bearings wherein a plurality of operations are performed selectively and continuously thereby greatly to reduce waste material, increase yield rate and improve the speed of production, and with a reduced number of processing steps and increased productivity.

The invention also dispenses with additional special machines to thereby reduce production costs.

According to the present invention a plurality of working steps are automatically and continuously followed to thereby increase productivity.

The present invention offers, in particular, the advantage that when edge trimming are effected, an allowance of about 0.2 mm will be sufficient as contrasted with an allowance of about 1.5 mm which must be maintained when a prior art method is used wherein the edge trimming is effected after cylindrical or other semi-finished products have been obtained as described hereinabove. This means that the allowance is larger in the prior art method by seven-times than the method according to the present invention, indicating that the amount of waste material is greatly reduced in the latter.

The invention may be carried into practice in various ways but one specific embodiment will now be described by way of example, with reference to the accompanying drawings, in which:—

FIGURE 1 is a plan view of a bimetal strip of a large width used in a method according to the invention;

FIGURE 2 is a sectional view, on an enlarged scale, taken along the line II—II in Figure 1;

FIGURE 3 is a plan view of further, narrow bimetal strips obtained by slitting the bimetal strip shown in Figure 1 lengthwise thereof;

FIGURE 4 is a schematic side view of an apparatus showing the production steps of the method according to the invention;

FIGURE 5 is a cross section, on an enlarged scale, taken along the line V—V in Figure 4;

FIGURE 6 is a cross section, on an enlarged scale, taken along the line VI—VI in Figure 4; and

FIGURE 7 is a cross section, on an enlarged scale, taken along the line VII—VII in Figure 4.

A bimetal strip 1 of a large width shown in

Figure 1 is composed of two layers, namely, a backing steel layer 2 and a bearing allow layer 3. The bimetal strip 1 is cut lengthwise thereof (in the direction of an arrow L in Figure 1) by means of a slitter into a plurality of narrow bimetal strips 4 of a desired width as shown in Figure 3.

Referring to Figure 4, the narrow bimetal strips 4 are each wound around a pay-off drum 5 and a take-up drum 6. The strips 4 pass through a leveller 7 for straightening the strips 4, and a device 8 for cutting coarse chamfers on each of the corners 9 of the backing steel layer 2 (see Figure 5). The numeral 10 designates a device for effecting edge trimming and chamfering comprising an edge trimming broach 11, a broach 12 for chamfering on each of the corners 9 of the backing steel layer 2, and a broach 14 for chamfering on each of corners 13 of the bearing alloy layer 3. The numeral 15 designates a device for machining the surface of the bearing alloy layer 3 to form an oil groove 22 of a desired depth thereon. The numeral 16 designates a milling machine for effecting rough machining on the surface of the bearing alloy layer 3 to give a substantially uniform thickness thereto. The numeral 17 designates a broach for cutting the surface of the bearing alloy layer 3 to give a desired thickness thereto. The broach 17 may be replaced by a fixed cutter.

Although not shown, one or more devices for forming an oil hole, an oil sump and an oil groove may be provided intermediate the leveller 7 and the device 8 for cutting a coarse chamfer on each of the corners of the backing steel layer 2, depending on the material, type and use of the bearings. These devices may comprise, for example, a device for punching the metal strip for forming an oil hole, an embossing device for forming an oil sump of the ball-indentation type formed with a plurality of circular recesses, and an embossing device for forming oil grooves of a variety of shapes. The use of embossing devices for forming an oil sump and an oil groove offers the advantage that the oil sump and oil groove can be formed in any desired shape.

In order that the bimetal strip 4 may move at the same speed as a whole when the method according to the invention is carried into practice, a portion or portions of the bimetal strip 4 may be loosened in front and behind of each of the aforesaid devices, although such loosened portions are not shown in the drawings.

In forming an oil groove, any one of the oil groove cutting device 15 and the embossing device may be selectively used provided that the grooves formed by the aforesaid two devices are of the same shape. The oil groove formed by the oil groove cutting device 15 according to the invention is a straight groove located parallel to the length of the bimetal strip 4. Therefore, when it is necessary to form an oil groove of a shape other than a straight-line groove, the aforesaid embossing device may be additionally provided. However, when it is desired to cut an oil groove of a desired shape by using the oil groove cutting device 15, it bec~~omes necessary~~ to provide a special device or attachment to the oil groove cutting device 15 to impart the necessary function thereto.

Operation of the method with regard to various steps will now be described. Referring to Figure 4, the bimetal strip 4 paid off from the supply drum 5 in the direction of an arrow M is straightened by the leveller 7 and passed through the device 8 for cutting a coarse chamfer on each of the corners of the backing steel layer 2 where the corners 9 of the backing steel layer 2 are subjected to coarse chamfering to provide coarse chamfers as shown at 18 in Figure 5.

The bimetal strips 4 are cut along their sides by the edge trimming broach 11 of the device 10 for effecting edge trimming and cutting chamfers to finish the side faces 19 to a desired width. Then, finish chamfering is performed by the fine chamfering broach 12 to the coarsely chamfered portion 18 of the backing steel layer 2, to produce the finished chamfered face 20 as shown in Figure 6, and the corners 13 of the bearing alloy layer 3 are cut by the fine chamfering broach 14 to provide finished chamfer portions 21 as shown in Figure 6. The bimetal strips 4 released from the device 10 are formed with an oil groove 22 by the oil groove cutting device 15 as shown in Figure 7, and wound on the take-up drum 6 after a desired thickness has been given to the bearing alloy layer 3 by milling the surface of the bearing alloy layer 3 with a milling machine 16 and then edge trimming broach 17.

The bimetal strips 4 subjected to the aforesaid machining is cut into blanks of a desired length. The blanks are then worked by a known press forming process, a three-roll forming process, a multi-forming process, etc., to produce bearings of a desired shape, such as wrap-formed bushes, semi-circular thrust washers, bearings of the semi-cylindrical shape etc. When the wrap-tormed bushes and the bearings of the semi-cylindrical shape are produced, the bearing alloy layer 3 is usually positioned on the inner side of the products.

In the preferred embodiment of the invention shown and described hereinabove, bimetal strips each composed of a backing steel layer and a bearing alloy layer are used. It is to be understood, of course, that the invention is not limited to this specific form of strips, and that solid bearing strips or multilayer bearing strips produced by known casting or sintering means may be used. In the embodiment shown and described hereinabove, mechanical cutting means such as broaches are used for trimming edges to have a desired width and cutting chamfers. However, roll forming means may be used, instead for shaping the bimetal strips. In finish machining the thickness of the bearing alloy layer, roll forming means may be used in place of the milling machine, broach and fixed cutter, to effect a reduction in thickness by means of rolling. A width adjusting operation, a chamfering operation, a thickness adjusting operation, an oil hole forming operation, an oil

sump forming operation and an oil groove forming operation may be selectively practiced, depending on the kind of material, type and intended use of the bearings. In the embodiment shown and described hereinabove, a leveller is used to raise the degree of dimensional accuracy with which the bimetal strip is worked (to improve the quality of the products). However, the leveller 7 may be dispensed with if the bimetal strip 4 has very few bends. Stated differently, the leveller 7 may be selectively used depending on the use to which the products are put.

From the foregoing description, it will be appreciated that the method of the present invention is provided for producing bearings of a desired shape from planar metal strips. In the present invention, the metal strip is continuously formed and/or machined longitudinally thereof, to selectively perform one or more than two of the operations such as an oil hole forming, an embossing, a width adjusting, a chamfering, an oil groove forming and a thickness adjusting operation depending on the shape and construction of the desired products. It will be apparent that the method according to the present invention offers the advantages that the number of processing steps is reduced, yield rate and production speed are increased, and shaped metal strips for making bearings can be economically produced, as compared with a method of the prior art wherein blanks of a desired shape are first punched out from metal strips and then blanks are formed and/or machined.

CLAIMS

1. A method of continuously making shaped metal strips for producing bearings from metal strips of single layer or composite multi-layer construction, which comprises the steps of:

selectively and continuously performing more than one of the operations, including oil hole forming, embossing, width adjusting, chamfering, oil groove forming and thickness adjusting operation on each of said metal strips for producing bearings as the metal strip is moved lengthwise thereof.

2. A method of continuously making shaped metal strips for producing bearings from metal strips of single layer or composite multi-layer construction, which comprises the steps of:

supporting each of said metal strips in a substantially horizontal plane:

selectively and continuously performing at least one of the operations of an oil hole forming, an embossing, an edge trimming, a chamfering, an oil groove forming and a thickness machining on the metal strip for producing bearings whilst, said metal strip is supported in a substantially horizontal plane and is moved lengthwise thereof.

3. A method of continuously making shaped metal strips for producing bearings as claimed in Claim 1 or Claim 2, wherein said oil hole forming operation is performed by punching.

4. A method of continuously making shaped metal strips for producing bearings as claimed in Claim 1 or 2, wherein said embossing operation is performed for forming an oil sump and/or an oil groove.

5. A method for continuously making shaped metal strips for producing bearings as claimed in Claim 2 wherein said edge trimming operation, said chamfering operation and said thickness machining operation are performed by using cutting means or roll forming means.

6. A method for continuously producing shaped metal strips for producing bearings as claimed in Claim 1 or 2, wherein said oil groove forming operation is performed by using cutting means.

7. A method for continuously producing shaped metal strips for producing bearings as claimed in Claim 4, wherein said oil sump and/or said oil groove are of a desired shape.

8. A method for continuously producing shaped metal strips for producing bearings as claimed in Claim 6, wherein said oil groove forming operation is performed to form a straight groove extending parallel to the length of the metal strips.

9. A method for continuously producing shaped metal strips for producing bearings as claimed in any one of the preceding claims, further comprising the steps of paying said metal strip out of a supply drum, straightening the metal strip by using a leveller, and winding said metal strip on a take-up drum after said operations are performed.

10. A method for continuously producing shaped metal strips for producing bearings as claimed in any one of the preceding claims, further comprising the step of cutting said metal strip longitudinally thereof to give a desired width thereto before performing said operations.

11. A method for continuously producing shaped metal strips for producing bearings as claimed in any one of the preceding claims wherein said bearings are fabricated as wrap-formed bushes or bearings of a half-cylinder shape.

12. A method of making a shaped metal strip substantially as described herein with reference to the accompanying drawings.

13. A strip when produced by the method of any one of the preceding claims.

14. A bearing made from a strip as claimed in Claim 13.

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